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**ORGANIZATION AND METHOD OF BASIC RECORDING AND CONTROL  
OF VACCINATION AGAINST INFECTIOUS DISEASES IN CZECHOSLOVAKIA**

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**Introduction**

In Czechoslovakia great attention has been devoted to problems of specific prevention of infectious diseases, particularly during the past ten years. The adverse epidemiological situation as far as some infectious diseases are concerned, before the Second World War and particularly after the war, the great social changes leading to ever increasing employment of women and thus to a greater use of collective facilities for children (crèches, nursery schools) - were factors which stimulated more profound epidemiological and immunological research and the extension of vaccination against infectious diseases in practice.

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The aim of the present paper is to give an account of the practical method of basic recording and control of vaccination, and not a critical analysis of scientific work carried out in this field in Czechoslovakia. I should only like to mention that scientific research in epidemiology, microbiology and immunology is being carried out by several research institutes of the Ministry of Health ( Institute of Epidemiology and Microbiology in Prague and Bratislava, Institute for Sera and Vaccines, Tuberculosis Research Institute in Prague), institutes

of the Czechoslovak Academy of Sciences ( Institute of Biology in Prague and Institute of Virology in Bratislava), in the microbiological institutes of seven medical faculties and regional hygiene and epidemiological stations which were established in all regions of Czechoslovakia.<sup>+/</sup> Research work produced by these institutes is published mostly in national scientific journals, particularly *Československá epidemiologie, mikrobiologie, imunologie* ( Czechoslovak Epidemiology, Microbiology and Immunology), *Hledy v tuberkulóze* (Czechoslovak Review of Tuberculosis and Pulmonary Diseases), *Československá pediatrie* (Czechoslovak Paediatrics), *Praktický lékař* (The General Practitioner), *Lékařský obzor* (Medical Review) and others, as well as in international journals, particularly the Journal of Hygiene, Epidemiology, Microbiology and Immunology. Scientific work which is part of a uniformly coordinated State Research Plan, is the main basis for the practical organization of vaccination.

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Before the Second World War, and to some extent also after the war, the only vaccination carried out on a mass scale was vaccination against smallpox which was not particularly difficult to record and control. Only after 1947 when the Act on compulsory vaccination against diphtheria was passed, and particularly after 1952 when the Ministry of Health published the first decree on the vaccination against infectious diseases, containing regulations on the compulsory vaccination against a greater number of infectious diseases ( tuberculosis, diphtheria, smallpox, whooping cough etc.) substantial changes as compared with the previous period took place. The problem arose how to coordinate, record and control this large number of vaccinations properly. The present paper gives an account of the basic principles of this recording and control of vaccination, without dealing

+/ The territory of Czechoslovakia is divided into 22 regions and 298 districts.

with more profound aspects of these problems which are dealt with in scientific publications.

# I

## THE ORGANIZATION OF VACCINATION

~~CONFIDENTIAL~~

The organizational basis regulating the vaccination against infectious diseases is the Decree of the Ministry of Health on the Vaccination against infectious diseases, based on the law on the hygiene and epidemiological service<sup>\*/</sup>, published first in 1952 and supplemented at the end of 1958.

### Types of Vaccination

According to the above decree there are the following types of vaccination in Czechoslovakia :

1. regular vaccinations : against tuberculosis, diphtheria, tetanus, whooping cough, smallpox and poliomyelitis,
  2. special vaccinations : in persons particularly threatened by infection,
  3. extraordinary vaccinations: in case of danger of an epidemic.
- All these vaccinations are compulsory and free of charge.

The problem of compulsory vaccination is more or less theoretical. Theoretically it is based on the principle that an infectious disease is not the concern of the individual and thus it is not the matter of protection of the individual from the disease but of the entire community. In practice, however, no repressive measures are used. Proper health education of the population plays a decisive role because it leads to a high standard of health consciousness and thus also to a high

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<sup>\*/</sup> Act no.4/1952, Sbírka zákonů a nařízení Republiky Československé

participation rate of the population in the vaccination, because the population is aware of the value and purpose of the vaccination. As an example we may quote the first vaccination scheme against poliomyelitis in 1957, where as a result of health education the participation of the population was very high (national average 87 per cent), though the first two doses of the vaccine were administered within two months.

When considering these problems we must, however, not under-rate the second important factor, i.e. that the vaccination is free of charge; this applies in Czechoslovakia to all types of vaccination and to health care in general.

#### Organization and Control of Vaccination

Vaccination is planned, organized <sup>and</sup> controlled by the Chief Hygienist of the Czechoslovak Republic at the Ministry of Health, his work being guided by his Advisory Commission ( the serum and vaccine commission) and research institutes. According to orders of the chief hygienist, regional and district hygienists organize and control the vaccination in the regions and districts. The vaccination against tuberculosis is organized by the regional and district phthisiologists.

Note: The chief, regional and district hygienist are, according to the nomenclature of the law on the hygiene and epidemiological service "organs of the hygiene and epidemiological service", i.e. heads of the hygiene and epidemiological service of the entire Republic ( Chief Hygienist of Czechoslovakia) the region (regional hygienist) or the district ( district hygienist). They have the power to control sanitary and epidemiological conditions not only in general but also in all institutions providing

cureative care. The research institutes which are at the disposal of the chief hygienist for organizing the vaccination, include in particular the Institute of Epidemiology and Microbiology in Prague and Bratislava and the Institute for Sera and Vaccines. Regional hygienists are helped by their regional hygiene and epidemiological stations, district hygienists by district hygiene and epidemiological stations. The regional stations and so far about 15 per cent of the district stations have completely equipped microbiological and usually also virological laboratories. For the practical vaccination control in the regions and districts specially trained health workers proved particularly useful (so-called sanitary workers).

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Vaccination are carried out by doctors only, mostly by paediatricians of the normal network of institutions for the preventive and cureative care, with the technical assistance of nurses. In mass vaccination campaigns (e.g. the vaccination against poliomyelitis in 1957) the help of voluntary health workers of the Czechoslovak Red Cross who helped professional health workers in organizational and clerical work proved very useful.

Note: In Czechoslovakia it is not the task of special doctors of the public health service to carry out vaccinations because all doctors are employed by the state health services. The Czechoslovak Health Services are divided, to ensure effective division of labour, into preventive and cureative services and the hygiene and epidemiological service. Vaccination is carried out by doctors of the preventive and cureative service, particularly paediatric<sup>y</sup>ians. The vaccination of children is concentrated mostly in child welfare centres ( children's

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departments of health centres) and in the surgeries of the school health service. Newborn infants are vaccinated against tuberculosis in the maternity hospital, older children in calmettisation centres of the tuberculosis departments of polyclinics.

### Time and Methods of Vaccination

#### 1. Regular vaccinations:

##### a) V a c c i n a t i o n   a g a i n s t   t u b e r c u l o s i s

The basic vaccination is done on the fourth day after birth in the maternity hospital, or within six weeks after birth in a calmettisation centre. Subsequent vaccinations depend on the result of the tuberculin test and are done in the course of the first, fifth and last year of compulsory school attendance and in the year when the individual reaches the age of nineteen, twenty-five and thirty years.

Note: At present a broad discussion on the problem of tuberculosis is taking place, the epidemiological aspects of the problem are discussed by Raška in the Časopis lékařů českých (1958). A detailed appraisal of the vaccination against tuberculosis was made by Šula, Vojtek and Galliová.

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##### b) V a c c i n a t i o n   a g a i n s t   d i p h t e r i a ,

t e t a n u s   a n d   w h o o p i n g   c o u g h . The primary vaccination consists of three injections of mixed vaccine.

In view of the fact that adsorbed vaccine is commonly used, the intervals were preliminarily fixed as follows: between the first and second injection there is an interval of six weeks, between the second and third injection an interval of six months. The first injection of mixed vaccine is administered to children aged three to five months. The next revaccination (after the primary vaccination has been completed) is given three times.

in the form of a single injection : in the year when the child reaches the age of three and during the first and third year at school ( the last injection does not contain the whooping cough component). Pre<sup>s</sup>chool children which attend crèches and nursery schools or live in childrens homes are in addition vaccinated every year against diphteria.

petit Note: The problem of the combination of antigens and of the vaccination time is at present the subject of research. So far the above mentioned schedule has been accepted, but at the same time non-adsorbed vaccines are tested, also in combination with polio vaccine; this would of course require a change of the vaccination times.

c) V a c c i n a t i o n a g a i n s t s m a l l p o x . The primary vaccination is given between the sixth and eleventh month of life, i.e. between the second and third injection of the mixed vaccine against diphteria, tetanus and whooping cough. Children are revaccinated during the second and seventh year at school and later as required.

petit Note: Mass vaccination against smallpox is still continued in Czechoslovakia though the last case of smallpox in Czechoslovakia was recorded in 1926. We are of the opinion that the occasional occurrence of imported cases of smallpox into different European countries does not justify us to discontinue the vaccination.

d) V a c c i n a t i o n a g a i n s t p o l i o m y e l i t i s was introduced after the first mass campaign in 1957 also as a common regular vaccination. Conforming to valid regulations , Salk inactivated vaccine is used according to the usual schedule i.e, with an interval of 2 - 6 weeks between the first and second injection and a minimal interval of seven months between



the second and third injection. The first injection is administered to the children at the age of seven months ( after a minimum interval of six weeks after the vaccination against smallpox, or two weeks after other vaccinations and three months after calmettisation). The vaccine is at present (contrary to the first vaccination campaign in 1957 when the vaccine was administered intradermally, administered subcutaneously, a dose of 1 ml.being used.

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Note: Similarly as in other countries, in Czechoslovakia intense research is devoted to the problem of vaccination against poliomyelitis. After the first mass campaign in 1957 which is believed to have exerted a significant influence on the epidemiological situation (Škovránek et al.: Journal of Hygiene, Epidemiology, Microbiology and Immunology II-4, 1958) at present the main problem is the period of immunity. To solve this problem extensive serological investigations were made at the end of 1958 and the beginning of 1959 in 140 000 children which had been previously vaccinated three times with Salk vaccine and to whom Sabin's live polio vaccine was administered. In addition to a similar group of children, at the time, a fourth dose of Salk vaccine was administered. We <sup>are</sup> also testing a combination of Salk vaccine with three basic antigens (diphtheria, tetanus and Whooping cough). The results of these investigations will influence the final decision regarding the method and intervals of the administration of polio vaccine.

For all these regular vaccinations methods of recording and control are used which will be described in greater detail in the subsequent part of the present paper.

## 2. Special vaccinations:

For special vaccinations the fundamental principle applies that it is carried out in persons exposed to an increased danger from some infectious disease in their profession. This ~~danger~~ concerns mainly employees of the health and veterinary services, transport, urban sewage stations, some types of industry where imported raw materials are processed etc. These individuals are vaccinated mostly against tuberculosis, smallpox and typhoid fever. This group includes also vaccinations against tetanus in injured persons who were not immunised actively previously (simultaneous vaccination administered at the same time as tetanic serum), vaccination with anti-rabies vaccine after bites from suspicious animals and vaccination before journeys abroad according to valid international regulations.

These vaccinations are recorded mainly by doctors in factory health centres or in special institutions ( e.g. in the Institute of Epidemiology and Microbiology in Prague, which is the centre for vaccination against yellow fever).

## 3. Extraordinary vaccinations:

These include any vaccination in the case of a threatening epidemic. This vaccination can be ordered without any other legal measures by the Chief Hygienist of the Czechoslovak Republic (if it concerns vaccination carried out on a national scale) or with his permission by the regional hygienist ( if the vaccination is to be carried out in one region).

In practice this power is used mainly for vaccinations against influenza or against smallpox in certain exposed persons (in the borderline guards, customs officers etc.), in case there are cases of smallpox in European countries.

Special powers:

The Chief Hygienist of the Czechoslovak Republic has the power to order different terms or different methods of vaccination <sup>spe</sup> than given in the above-mentioned Act, in view of results of scientific research. This renders it possible to respond very readily to the results of scientific research and it is a very important factor which makes it possible to maintain a high up-to-date standard of vaccinations.

## II

RECORDING AND CONTROL OF VACCINATION  
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The large scope of different types of vaccination in Czechoslovakia which were introduced during the period of reconstruction of the entire health services, some adverse phenomena in the epidemiological position ( particularly as far as diphtheria and tuberculosis are concerned) and the initial difficulties associated with establishing an epidemiological and paediatric service required great attention for problems of recording and control of vaccination. The right solution of these problems was by no means easy not even in a country with a unified state organization of the health services, though we must admit that without this organization it would have been far more difficult.

We are aware of the fact that the vaccination control in its entire scope is not merely a question of keeping records of the persons vaccinated and their numbers, and that we must differentiate between several types of control :

1. the control of the quality, effectiveness and innocuousness of the vaccines and sera ( research and state control of sera and vaccines),

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2. the control of the effectiveness of sera and vaccines when used on a large scale ( epidemiological control, field trials),
3. control of the number and appropriate time of vaccination.

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The subject of the present paper is, as has been stated in the introduction, the method of control of the number and appropriate time of vaccination which is the fundamental basis for all subsequent considerations. It would be, however, an undue simplification of the problem to assume that this is the only adequate approach to the solution of the whole problem.

The control of vaccination, according to principles which will be given in greater detail below, was begun in 1955. The reason why these national annual controls were carried out (1956, 1957, 1958) was the finding that the commonly used quarterly reports on the number of vaccinations did not give an accurate account of the actual position of immunity of individual groups of children nor on the standard of work of the vaccinating doctors, on the respecting of vaccination times, etc.

These controls made it possible

1. to consolidate the organization of vaccination and to coordinate mutually the individual types of vaccination,
2. record all children subject to compulsory vaccination and thus to establish special health records of children,
3. do away gradually with the most serious shortcomings and complete missing vaccinations, particularly against diphtheria,
4. increase the doctor's responsibility for vaccinations,
5. introduce aimed health education concentrating on the main shortcomings revealed, and thus gradually increase the interest of the public in vaccination, this being the primary condition of success.

The data assembled as a result of these controls formed the main basis for mastering the mass vaccination against poliomyelitis in 1957 and for the amendment of vaccination orders in 1958.

#### A. PRINCIPLES OF RECORDING AND DOCUMENTATION OF VACCINATION

There were two fundamental problems:

1. where should the basic records of vaccinations be kept,
2. how to certify the vaccination to individuals.

The second question was solved by the so-called vaccination certificates where all vaccinations are recorded (see specimen 1). The mother must produce the vaccination certificate every time the child is vaccinated and also when he registers for school.

petit The problem where the records on vaccinations should be kept was more difficult: at the health community doctor or the paediatrician or school health service doctor. The problem was solved as follows: the basic records are concentrated mainly in paediatric centres (in childrens departments of health centres and the surgeries of the school health service). Records of vaccinations against tuberculosis which does not include only children but also adults, are kept at the tuberculosis departments of district institutes of national health.

#### Basic Forms for Recording

1. Every child is registered immediately after birth in the paediatric department of the health centre by a "Report on terminated pregnancy" which is sent by the responsible doctor of the maternity hospital, if the child was born in a maternity hospital or if the child was born at home by the attending doctor or midwife ( specimen of form see enclosure 2 ).

2. The name of the child is entered in the health centre after the "report on terminated pregnancy" has been received, into a special diary called "Children born in ...." where there is also space for data on vaccination ( see specimen of form enclosure 3). At the same time the childrens department fills in for every child an individual "Record on the Health and Diseases of the Child (enclosure 4).
3. In preschool children which attend collective facilities, such as crèches and nursery schools ) data on the vaccinations are recorded in addition to the records of the childrens department of the health centre also in special records kept in these institutions i.e. in the Record of the Child Attending Crèche ( enclosure 5) or in the "School Health Record for Nursery Schools (enclosure 6).
4. When the child enters school it is the duty of the parents to produce the vaccination certificate. In case this has been lost, the data are obtained from records kept at the childrens department of the health centre ( see above). The school health service doctor prepares for every child a "School Health Record" (enclosure 7). For vaccinations the school management prepares in addition "Lists of Pupils for Vaccination" (enclosure 8) in two copies: one list is kept by the doctor of the school health service, the second is sent to the calmettisation centre.
5. If any change of the permanent address occurs all records concerning the preschool or school child are sent to the health centre ( childrens department) of the new domicile.

Note: 1. Vaccinations against tuberculosis are recorded separately at the tuberculosis department of the District Institute of National Health ( calmettisation centre). If the newborn infant

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was vaccinated he receives a "Calmettisation card" (enclosure 9), which serves as basic information for subsequent immunobiological tests or subsequent vaccinations. At the same time the child receives a vaccination card which serves for records of all future vaccinations. If the calmettisation could not be carried out at the appropriate time because of counterindications, the child receives only the calmettisation card with a note to that effect and no vaccination card.

2. Because the records and documentation of vaccinations in the youngest children are not kept separately but in conjunction with other health records ( see specimens 4,5,6,7 ), where all changes of the health of the child are recorded the doctor who vaccinates the child has at his disposal all data on the child's health condition and can take the appropriate precautions when vaccinating the child.

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3. These records are rendered more accurate and are supplemented in collaboration with other organs of the state administration, (particularly district organs of the State Statistical Office, local national committees and the militia), which are at the disposal of the doctors and from which they may abstract necessary data or if necessary demand complete lists of vaccinated individuals of a certain age group.

4. The network of childrens departments of health centres (child welfare centres) was established in the whole country, not only in towns but also in rural areas. In rural areas where there is no full-time paediatric service, the paediatrician pays regular visits to the localities. This makes it possible to ensure uniform basic records in the whole country.

5. In individual doubtful cases, particularly in older children where the records were <sup>not</sup> kept so accurately as at present

there is an individual procedure. In cases where it proves absolutely impossible to obtain data on vaccinations, the vaccinating doctor ensures, in agreement with the district hygienist, an individual plan of supplementary vaccination of the child. With the improving control and system of recording the number of such children is diminishing.

6. The recording of vaccination in adults is more difficult.

As far as students are concerned, their records can be kept in the health records of the particular school or university. As far as employees subject to special vaccination are concerned, their records are kept in registers of their working place or by the community doctor. The greatest difficulties are so far encountered with recording vaccinations of adults subject to vaccination against tuberculosis (up to the age of 50).

B. CONTROL OF VACCINATION RECORDS

The control of the vaccination records is made by

1. the vaccinating doctor through his staff of health workers,
2. organs of the hygiene and epidemiological service (district and regional hygienists).

ad 1/ Control of vaccination records by the vaccinating doctor: the vaccinating doctors must themselves or by means of their health workers (nurses) ensure the correctness of records from data contained in the report on the birth of the child, school records, demographic data and data supplied by appropriate organs.

ad 2/ Control by organs of the hygiene and epidemiological service:

a/ district hygienists make throughout the year random controls of the records kept by vaccinating doctors, on the



supplementation of records after a change of domicile etc. Once a year they carry out a general detailed revision which concentrates mainly on the number of vaccinated individuals as compared with statistical data, on the number of newborn infants reported by the State Statistical Office ( after subtracting the number of deaths). These controls are very important, not only from the point of view of controlling the standard of vaccination but also for planning the requirement of sera and vaccines.

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Note: Experience with this control work in the field has shown that health workers of the district hygiene and epidemiological stations (so-called sanitary workers) with a basic training in hygiene and epidemiology, prove very useful.

b/ Regional hygienists make similar random controls as district hygienists and control in addition the standard of the work of district hygienists. To control the completeness of the number of vaccinated subjects in individual districts they use methods common in vital statistics.

In practice the usual procedure is as follows:

Assuming any given number, e.g. 100,000 newborn children :

$l_0 = 100,000$ . The probability of death at age 0 is  $q_0$  and thus in the first year  $10. q_0$  children die and  $l_1$  children reach the age of one year, according to the equation

$$l_1 = l_0 - 10. q_0 = l_0 / 1 - q_0;$$

$$l_2 = l_1 - l_1 \cdot q_1 = l_1 / 1 - q_1 / \text{etc.}$$

We thus obtain a series of figures  $l_0 / = 100,000 / l_1, l_2, l_3 \dots$  the so-called decrementing order of living individuals. If we know the structure of the population at the time of the census we can estimate the age structure of the population after  $n$  years

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by means of the equation:

$$E_{x/n} = E_{x-n}^{(0)} \cdot \frac{1 \ x}{1 \ x - n}$$

where  $E_{x-n}^{(0)}$  is the number of individuals aged (x-n) years at the beginning of the census,  $E_x^{(n)}$  is the figure which gives the number of individuals still alive after n years. We thus can work out the number of children aged four, as follows:

$$E_4 = E_0 \cdot \frac{1_4}{1_0}$$

Because mortality tables are usually revised after ten years' intervals and the infant mortality in Czechoslovakia since 1948 has a steeply decreasing trend and the mortality rate of infants under one year could distort the calculation, we start from the figure  $E_1$  which is obtained when we subtract from the number of live born infants in a certain year ( e.g. 1954) the number of all children who died before reaching the age of one year during this particular year. The calculation is not quite accurate mathematically ( we subtract the number of children born during two years) but is quite satisfactory for practical purposes and we certainly commit a smaller mistake than if we used mortality tables where the rate of mortality during the first year is decreasing steeply. According to the above example we obtain the following equation:

$$E_4 = E_1 \cdot \frac{1_4}{1_1} \text{ etc.}$$

In our calculations we did not take into account any migration of the population. This can be neglected in calculations on a national scale and usually also in calculations on a regional scale; in some districts, however, the factor of migration had to be taken into account.

Experience gained from the period before national controls of the position and standard of protective vaccinations were

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revealed that the paediatric departments of health centres, district and regional hygienists did not have accurate records on the number of vaccinated individuals, born in different years. Therefore for all districts summary tables were worked out (regardless of migration) which gave, using the method described above, the approximate number of children born in individual years, who were alive in the year when the control was made. By means of this method the completeness of records of the global district and regional figures is checked<sup>ch</sup> every year during the national control of the state and standard of protective vaccinations. With the exception of a small number of districts where there is a more marked fluctuation of children, or some districts of the Ostrava region (steep rise of the number of inhabitants) this method provides on the whole a satisfactory basis for the estimation of the number of children according to individual years of birth, and with these figures the number of vaccinated individuals is compared; in cases where there are more substantial differences it is of course necessary to check the numbers with individual vaccinating doctors (by comparison with records on the number of births, records kept by the national committees etc.).

c) The Chief Hygienist of the Ministry of Health uses a similar procedure. National data obtained in the regions are compared with data on the age structure of the population. These data are provided by the State Statistical Office.

In the course of the last four years when the controls on the state and standard of vaccinations in Czechoslovakia have been carried out, it proved possible by the common effort of all health workers participating in the scheme or in its planning, organization and control to achieve that for all age

groups from 0 - 14 years there are at present almost complete records of all vaccinated individuals, this being the basis for further work.

### III.

#### CONTROL, TIME AND COMPLETENESS OF VACCINATION

The reason why we emphasize the need of checking the completeness of vaccination are generally known. We had the opportunity to realize the importance of the principle of collective immunity not only under certain actual epidemiological situations in the case of diphtheria, whooping cough or paraperitussis but also when preparing the mass vaccination against poliomyelitis in 1957.

We are, however, of the opinion that it is not correct to check the completeness of vaccination only from records giving the number of vaccinations, without investigating simultaneously the epidemiological position<sup>and</sup> regardless of the age and the specific morbidity rate of the vaccinated individuals.

When controlling the state and standard of vaccination we devote therefore special attention to controls of the vaccination of children by age (year of birth). In practice we investigate all vaccinations performed because this is simplest for the vaccinating doctor as well as for the controlling authorities; these investigations are, however, not done to obtain the total number of vaccinations and the data are

d i f f e r e n t i a t e d a c c o r d i n g t o  
i n d i v i d u a l y e a r s o f b i r t h .

In practice these controls have been done hitherto in preschool children because this was most urgent from the epidemiological point of view. Gradually we intended, however, to extend these controls also to older age groups.

#### A. AIDS USED FOR CONTROLS

##### 1. Forms for the control of the completeness of vaccination

are uniform and identical for all components of the health services from the health community to the district region up to the Ministry of Health. They were worked out for smallpox, diphtheria, tetanus, whooping cough and poliomyelitis. They are used for checking once a year the vaccination rate against these infections. (Specimens of the forms: 1. "Investigations on the vaccination of children against diphtheria, tetanus and whooping cough to the date of July 31, 1958", 2. "Investigation on the basic vaccination against smallpox to the date of July 31, 1958", 3. "Investigation of the vaccination of children against poliomyelitis to the date of July 31, 1958", see enclosure 10 - 12).

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Note: The control of the completeness of vaccination against tuberculosis is made by the district and regional phthisiologists in collaboration with regional and district hygienists according to their own records in the tuberculosis departments of the District Institutes of National Health.

##### 2. Nomograms of the appropriate time of vaccination

These aids elaborated for different types of vaccination were necessitated by the great number of vaccinations, particularly in the first year of life of the child. The

main purpose of these aids is to obtain rapid orientation on the adherence to vaccination times and intervals between individual injections and to take immediately the necessary reparative measures. An analysis of the vaccination time in conjunction with an analysis of the epidemiological position is a very valuable basis for planning and taking epidemiological measures, for research and for the production of sera and vaccines.

When constructing "nomograms" we relied on the principle that in a certain sufficiently large area the increment of the percentage of newborn children in individual months of one calendar year has a roughly linear trend. Thus it is for instance in January 8.33 % ~~per cent~~, in February also 8.33 % (i.e. in two months a total of 16.67 % of the yearly total) and thus in twelve a total of 100 % of children are born. When constructing this aid we do not take into account the neonatal mortality rate (up to the age of 28 days) not the postnatal mortality rate (29th day - to one year of age), because individual deaths are recorded in the child welfare centre. Nomograms were prepared on the time of the administration of the 1st, 2nd and 3rd injection of the basic vaccination against diphteria (since January 1, 1958 a combination of diphteria, tetanus and whooping cough) and the time of the basic vaccination against smallpox ( see enclosure ..... ). These nomograms can, of course, be constructed for any type of vaccination.

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The use of these aids is very simple as shown by the following example :

The first injection of the basic vaccination against diphteria, tetanus and whooping cough should be administered

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according to the vaccination schedule during the third to fifth month of life. We investigate the appropriate time of these vaccinations in children born between January 1st to July 31, 1958, i.e. when we investigate whether the first injection was not administered before the third month or after the fifth month of life. Among the children born between January 1 and July 31, 1958 ( $\frac{7}{12}$  -  $\frac{4}{12}$ ) children were older than three months (i.e. children born before May 1, 1958, and  $\frac{2}{12}$  were older than five months ( children born before March 1, 1958).

If we express these numbers in both cases as the ratio to the total number of children born between January 1 and July 31, 1958 (control day) and express it as the percentage we obtain in the first case :

$$V_{\max} = 100 \cdot \frac{\frac{4}{12}}{\frac{7}{12}} = 57.1 \% = \text{upper limit}$$

and in the second instance

$$V_{\min} = 100 \cdot \frac{\frac{2}{12}}{\frac{7}{12}} = 28.6 \% = \text{lower limit}$$

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If the percentage of children ascertained by the control which received the first injection against diphteria, tetanus and whooping cough ( $p = 100 \cdot \frac{v}{n}$ ) where  $v$  is the number of vaccinated children and  $n$  is the number of children born between January 1 and July 31 1958 lies within these two limits then the appropriate time of vaccination has been adhered to; if it is the lower limit the vaccination times were not adhered to and the reasons for this must be sought.

In a similar way the limits for the second and third injection of the basic vaccination against diphteria, tetanus

and whooping cough are determined as well as for the basic vaccination against smallpox ( see nomograms).

The method described has the advantage that the appropriate time of any vaccination can be followed month by month and immediate measures can be taken to improve shortcomings. This method is not only used by vaccinating doctors but also by workers of the district hygiene and epidemiological stations when doing random controls of the state and standard of protective vaccination.

#### B. THE METHOD OF CONTROL OF THE COMPLETENESS AND TIMELINESS OF VACCINATION

In the section on the control of vaccination records we have already mentioned the fundamental principles of these procedures, i.e. controls which are carried out by the vaccinating doctor and controls carried out by the organs of the hygiene and epidemiological service. In this section we shall deal with the practical working methods of the organs of the hygiene and epidemiological service.

Workers of the hygiene and epidemiological service make the following control investigations :

1. random controls throughout the year
2. controls to a certain date ( usually July 1 of every year).

Ad 1. For random controls workers of the district or regional hygiene and epidemiological stations use usually the "nomograms of the appropriate time of vaccination" (see the preceding section of this paper). The causes of lack of adherence to the proper terms are carefully analysed, also in conjunction with the epidemiological position, and serious shortcomings in the work of the vaccinating doctors are rectified on the spot or reported to the



higher health authorities. During these controls, of course, also other important questions are investigated e.g. the system of vaccination records, vaccination certificates, storage of vaccines and sera etc.

Ad 2. Annual investigations of the standard of vaccination. The control is done mainly by health workers of the district and regional hygiene and epidemiological stations in collaboration with institutions of the preventive and curative care, particularly childrens' departments of the health centres ( childrens' nurses) together with community doctors and doctors of the school health service ( community and school service nurses), with tuberculosis departments of the health centres, with the school administration etc.

Before the control proper there precedes a preparation which consists in enlightenment of the persons concerned, assembling the necessary data etc.

The object of control is in particular to find out how individual children born during different years are vaccinated. These data are summarized on forms ( see specimens of forms for 1958) where they are summed up for every child welfare centre and later for the whole district. After this work has been completed the indicator, i.e. the vaccination rate, is worked out the following formula being used :

$$p = 100 \cdot \frac{v}{e} \%$$

v is the number of vaccinated individuals,

e is the number recorded in the individual years controlled.

The indicator is worked out for individual communities of welfare centres and summarized for the whole district.

At the same time the time indicator of all vaccinations is worked out.

The object of this control is, however, not only the recording and documentation of vaccinations, the time of vaccination and its completeness but also to assess how vaccinations are organized in the area of the particular vaccinating doctor, how calmettisation is coordinated with other types of vaccination, how much time vaccinations take up in the working time of individual doctors ( number of vaccinations per year) and whether and how the parents are enlightened by the vaccinating doctor on the significance of vaccination and whether in all instances health education precedes the vaccination, etc. The work of the vaccinating doctor is also controlled as well as the storage of sera and vaccines etc. When <sup>the</sup> district hygienist participates in the control, he checks at random from the records ~~whether~~ whether the contraindications have been assessed correctly and whether and in which types of vaccinations and by what methods the results of the vaccination are checked by the vaccinating doctor, whether unusual cases and reactions after vaccinations are properly investigated and reported, etc.

After the control in the child welfare centre, at the community doctor or at the school has been completed, the results are summarized in a report which is discussed in detail with the vaccinating doctor, as far as shortcomings in vaccination are concerned, and agreement is made by what time and how they are to be removed.

The reports on vaccination controls concerning individual vaccinating doctors are summarized for the entire district and the conclusions from this report are again discussed with

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all vaccinating doctors during instruction courses.

The results from the districts are sent to the regional hygiene and epidemiological station, where they are verified and similar indicators as in the districts, are worked out for the entire region; in a similar manner the results from the regions are computed for the whole State.

In addition the results are expressed graphically to render them more instructive.

The importance of these controls consists in the fact that the vaccinating doctors themselves are greatly interested in the results of these controls and in removing possible shortcomings in protective vaccinations.

Though some serious shortcomings still persist, these controls were a real turning - point and led to a substantial improvement of the situation.

#### APPENDIX

#### EXAMPLES OF SOME RESULTS OF THE CONTROL OF THE TIME AND COMPLETENESS OF VACCINATION

Because the numerical results of controls of the state and standard of protective vaccination, particularly results relating to its time and completeness, are discussed by the organs of the national committees, at instruction courses of vaccinating doctors, paediatricians and community doctors, district and regional hygienists etc. and at the Ministry of Health, in the Advisory Board of the Minister, the graphical expression of these results which is very instructive has proved most suitable. The graphical computing for individual districts is made at all

regional hygiene and epidemiological stations; some larger district hygiene and epidemiological stations work out the results by communities of individual child welfare centres or according to the working area of individual vaccinating doctors.

The basic principle of all this computing is that

1. the results are computed by different years of birth,
2. that they are compared with similar results for previous periods.

Naturally the technique of computing of numerical results can differ greatly. As an example of regional computing by individual districts we should like to quote the results of the first and second national control made in the region Prague - rural ( to the date of August 31, 1955 and April 30, 1956) in the youngest age groups of children.

Fig. 3 gives the percentage in children vaccinated against diphteria before August 31, 1958, in children born in 1954 and 1955, by the first to third injection of the basic anti-diphteria vaccine, by individual districts, fig 4 the percentage of children vaccinated against smallpox in children born in the same years, whereby in children born in 1954 it is differentiated whether the vaccination was carried out before or after the child has completed the age of one year. The following figure indicates the percentage of vaccination rate against diphteria in children born in 1955 who have received all three injections of the basic vaccination against diphteria, whereby the time of vaccination is recorded ( maximal possible and minimal necessary vaccination rate to date of April 30, 1956 - second national control); similarly in the next figure the percentage vaccination rate <sup>against smallpox</sup> is given for children born in the

same year also to the date of April 30, 1956.

From the national results we should like to mention some which were obtained during the national control made to the date of July 31, 1958. Fig. 8 indicates how the vaccination times were adhered to; the data apply to children born in 1958 and to the first and second injection of the basic vaccination against diphtheria, tetanus and whooping cough. From the figure it appears that the time of the first and second injection was very well respected ( minimal necessary vaccination - see chapter on methods of investigating time of vaccination) and that it is even surpassed in the Czech regions and that the respecting of the time should be improved in view of the epidemiological position ( age distribution of whooping cough) in Slovakia. Fig. 9 The following figure 10 illustrates the respecting of the time as far as the completion of the basic vaccination against diphtheria in children born in 1957 is concerned. A similar figure, fig. 10 shows how the vaccination time in basic vaccinations against smallpox are respected. Fig. 11 gives the result of controls made in preschool children born during different years the percentage of children who have received all three basic injections against diphtheria and the first revaccination at the age of three and the second revaccination during the first year at school ( the figure gives the three best and three worst districts).

A similar figure 12 was constructed for the data on the completeness of vaccinations against smallpox, where in addition the percentage of positive results by individual regions was investigated. Results obtained by the control of vaccinations of newborn infants against tuberculosis are given in figure 13.

which presents regional data on the percentage of children where the result of the vaccination was positive.

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These figures related to the regional results of controls of the completeness of vaccination are used mainly in instruction courses of regional workers ( regional hygienists, paediatricians and phthisiologists) to illustrate the shortcomings which were revealed by the controls ( e.g. as far as the vaccination against tuberculosis is concerned we emphasize that even in the large numbers of vaccinated individuals the correct technique of vaccination and the correct dosage must be respected as well as the selection of the correct time for evaluating the results of postvaccination immunobiological tests, to ensure that the maximum number of protected individuals from the total number of vaccinated persons.

In the national computing of the results we follow in addition to the indicators also graphically the improvement ( or deterioration) of the position during the period between the two controls e.g. fig. \_\_\_\_\_ show an improved vaccination rate (basic and first and second revaccination) against diphteria and smallpox. On the figure relating to smallpox it is apparent that when the early vaccination time is not respected, the vaccination is continuously postponed for fear postvaccination encephalitis up to school age; the actual position as far as smallpox are concerned is by 10 - 15 % better ( particularly in Slovakia) because only documented results were used as a basis for our figures. Controls of the scars in children of the first form when vaccinated against smallpox have shown that these children were vaccinated during preschool age but the old certificates ( documentation of the doctor, vaccination

certificates were lost.

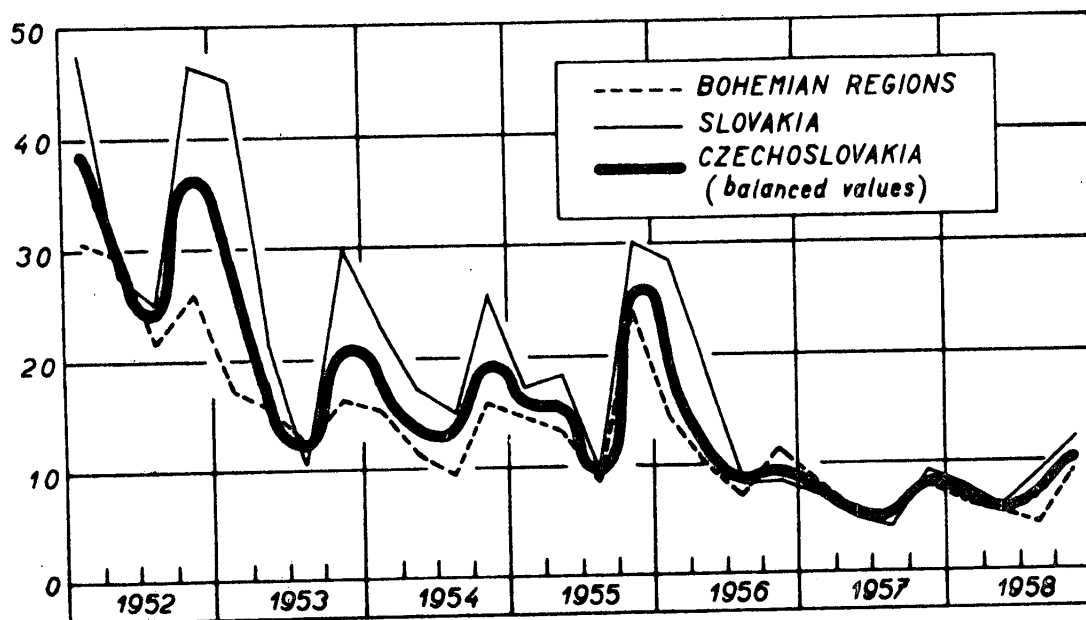
Interesting data are given in the next figure relating to vaccination against diphtheria in the Czech regions which indicates by how many per cent the vaccination rate has improved in various groups of preschool children in the period between individual controls. Parallel with the improved vaccination rate there was also a rapid improvement of the epidemiological situation where the morbidity rate during the past three years has decreased by two thirds as compared with 1955.

At the end of 1958 we have observed an increase of the morbidity rate but a detailed analysis in relation to vaccination revealed that most patients had not been vaccinated at all or vaccinated inadequately, or after incorrect time intervals. A detailed age analysis of the patients indicated that a substantial part of them belonged to the age group above 15 years (fig. 1) particularly in the Czech regions.

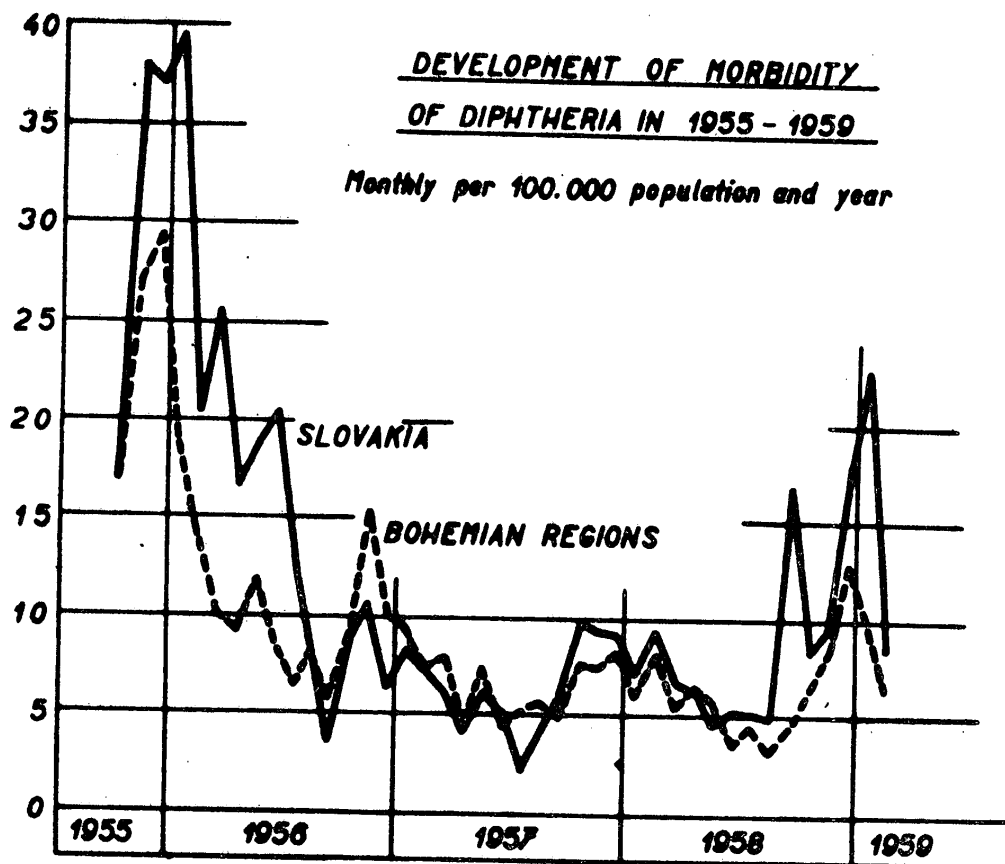
As far as some results of vaccination against poliomyelitis are concerned, they were evaluated <sup>after</sup> within the mass vaccination campaign of 1957 and were published in the Journal of Hygiene, Epidemiology, Microbiology and Immunology vol.II/4 Prague 1958.

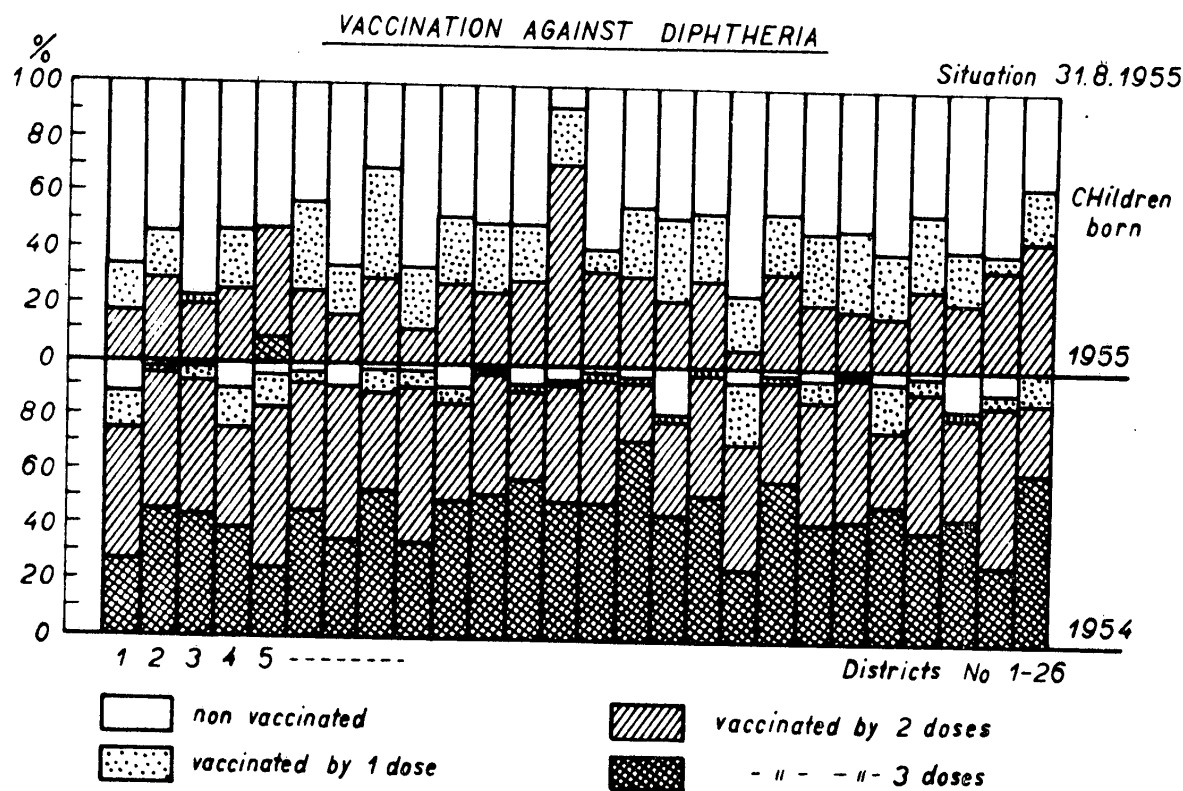
DEVELOPMENT OF MORBIDITY OF DIPHTHERIA IN 1952 - 1958

*Quarterly per 100.000 population and year*

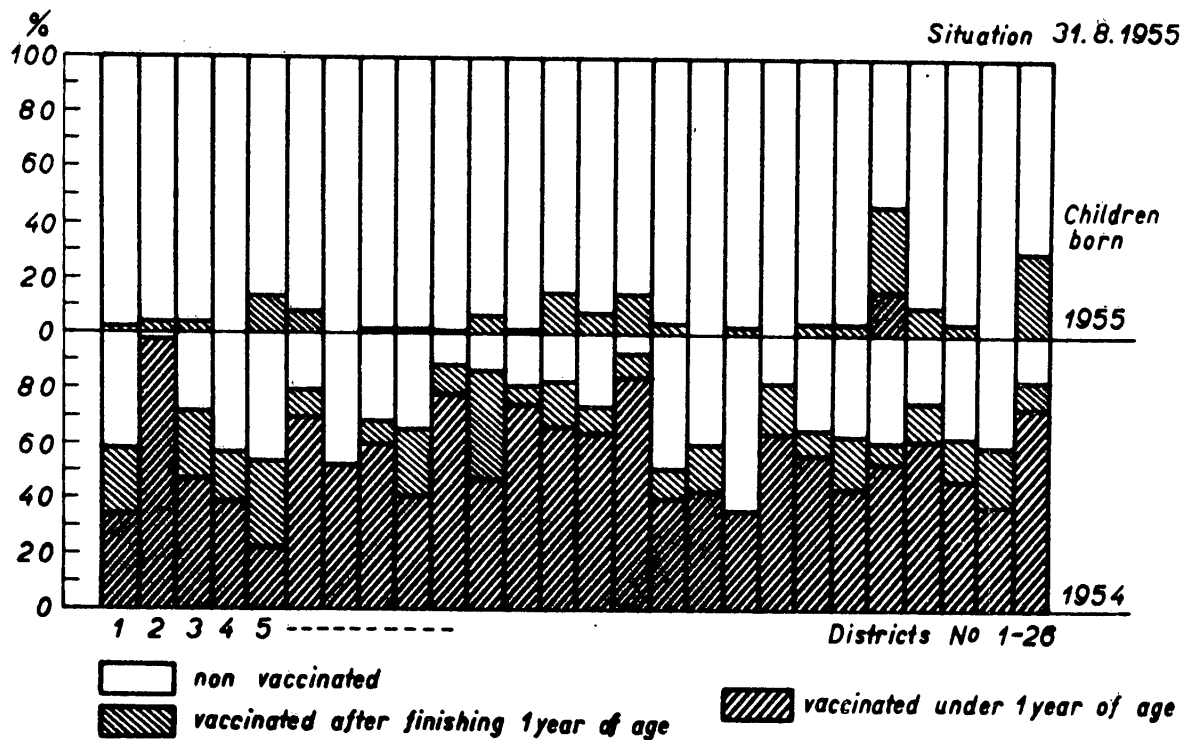






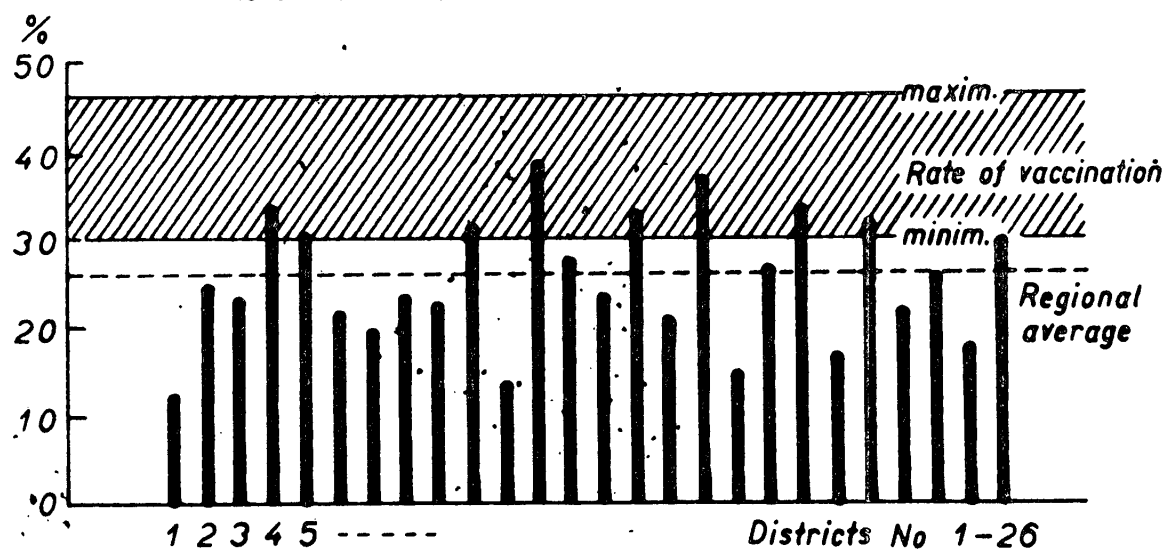


# VACCINATION AGAINST SMALLPOX



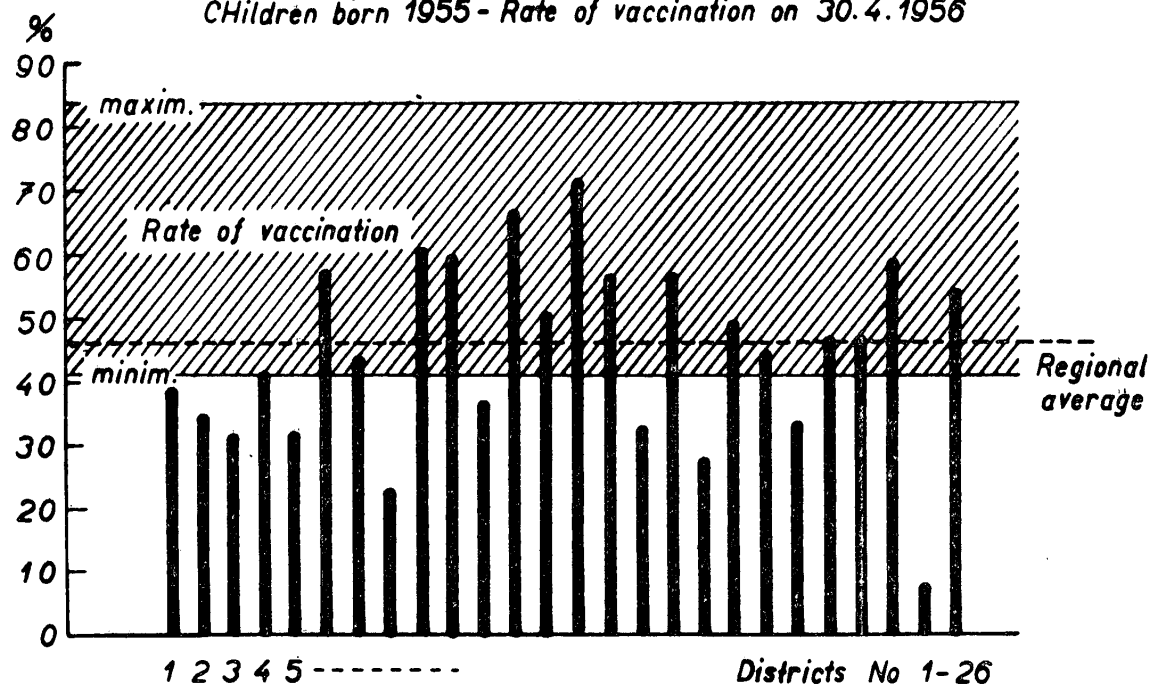
VACCINATION AGAINST DIPHTHERIA (Primary course finished)

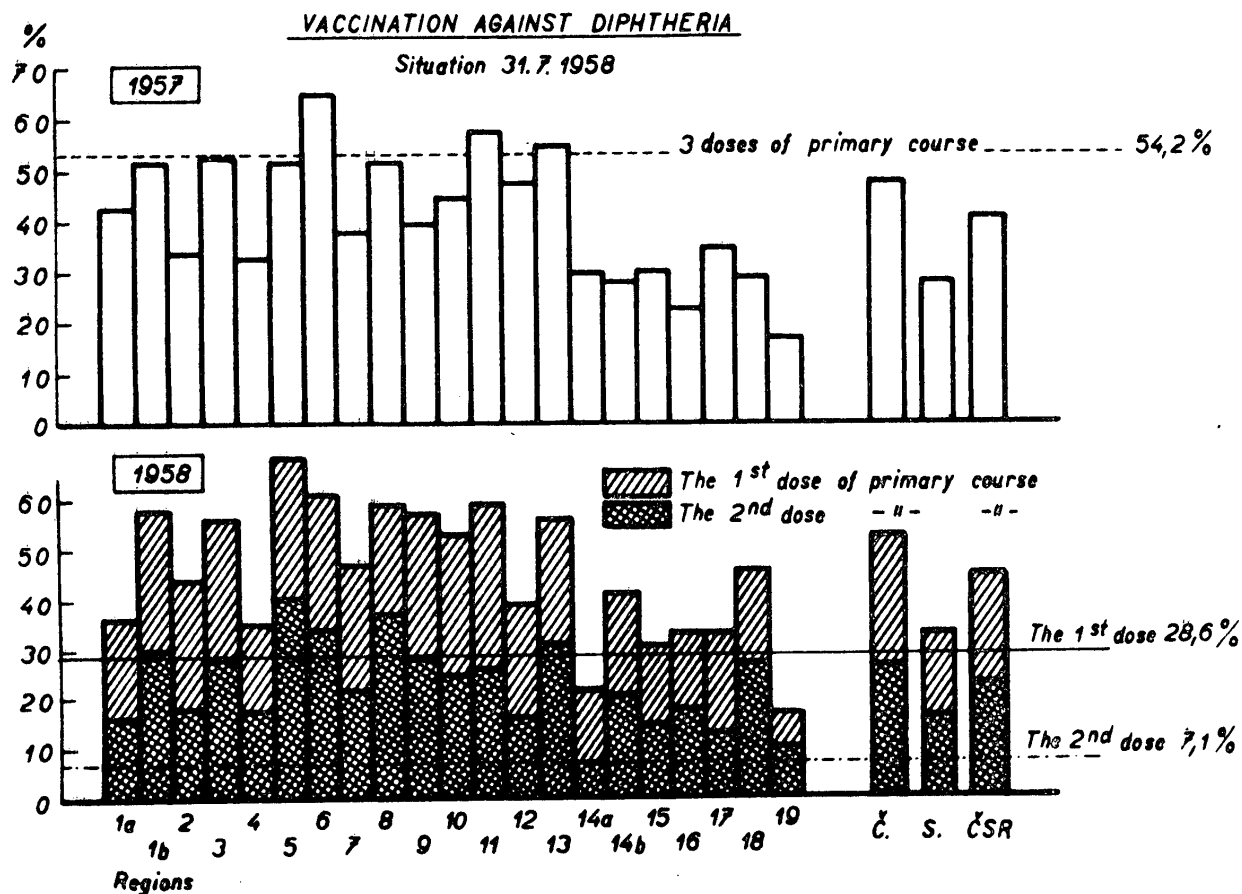
*Children born 1955 - Rate of vaccination on 30. 4. 1956*

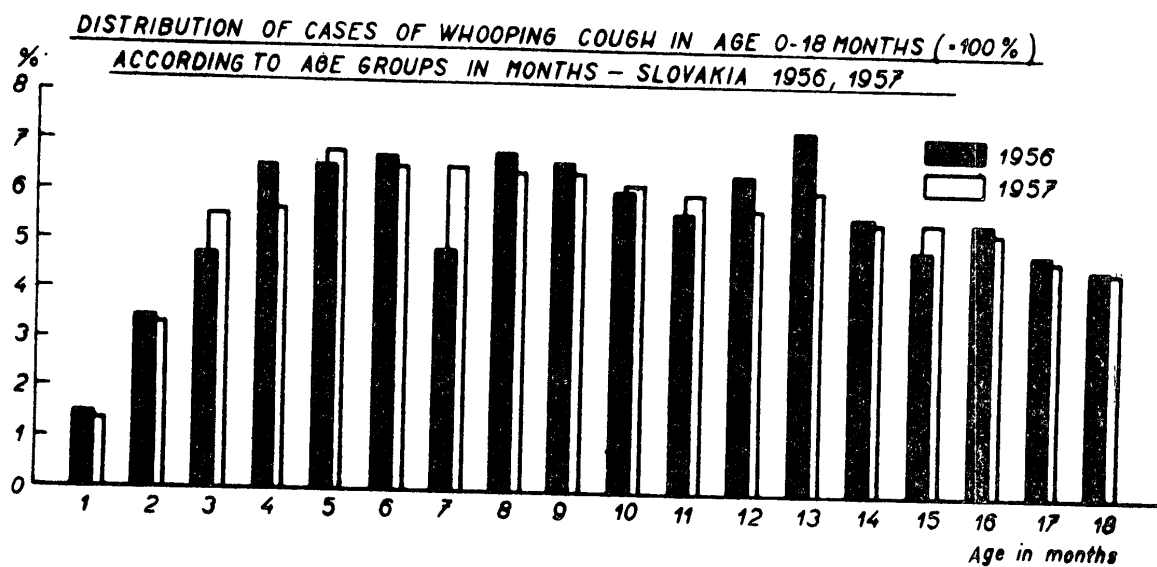


VACCINATION AGAINST SMALLPOX (Primary course finished)

*Children born 1955 - Rate of vaccination on 30.4.1956*

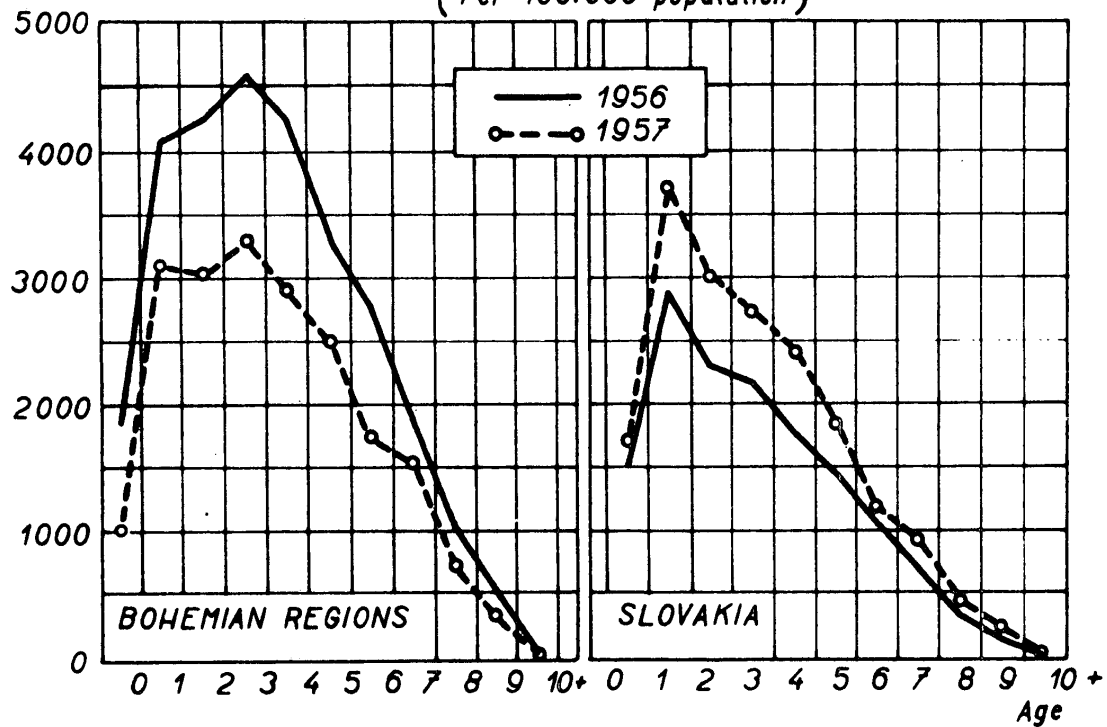




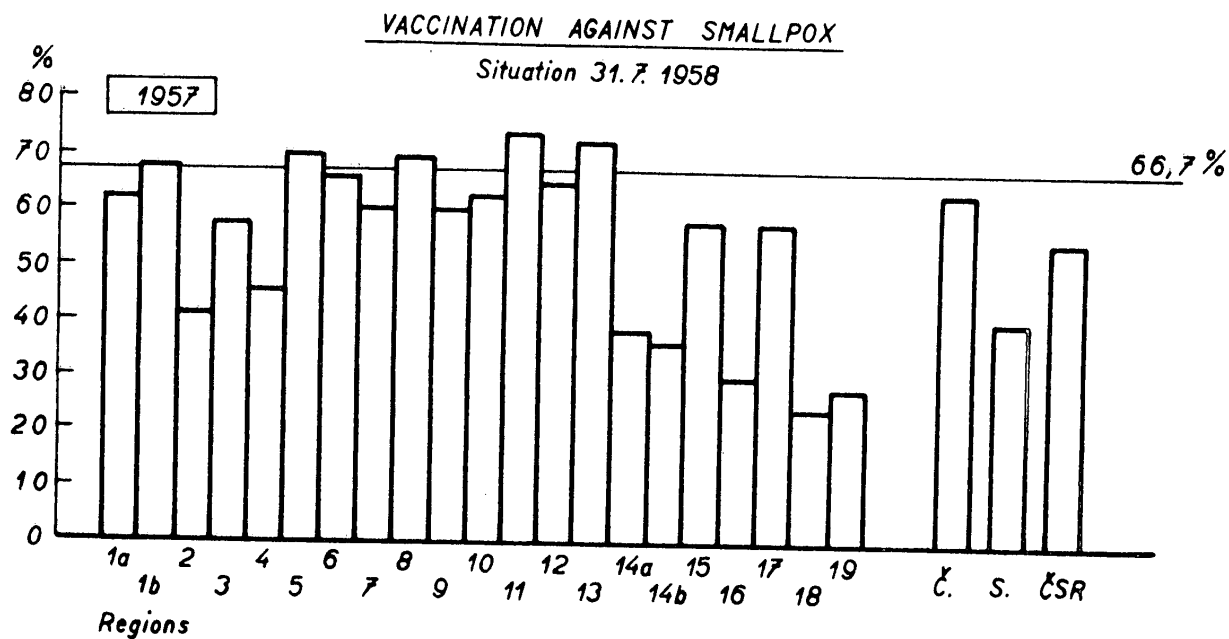


AGE MORBIDITY DUE TO WHOOPING COUGH IN CZECHOSLOVAKIA  
IN 1956 AND 1957

(Per 100.000 population)

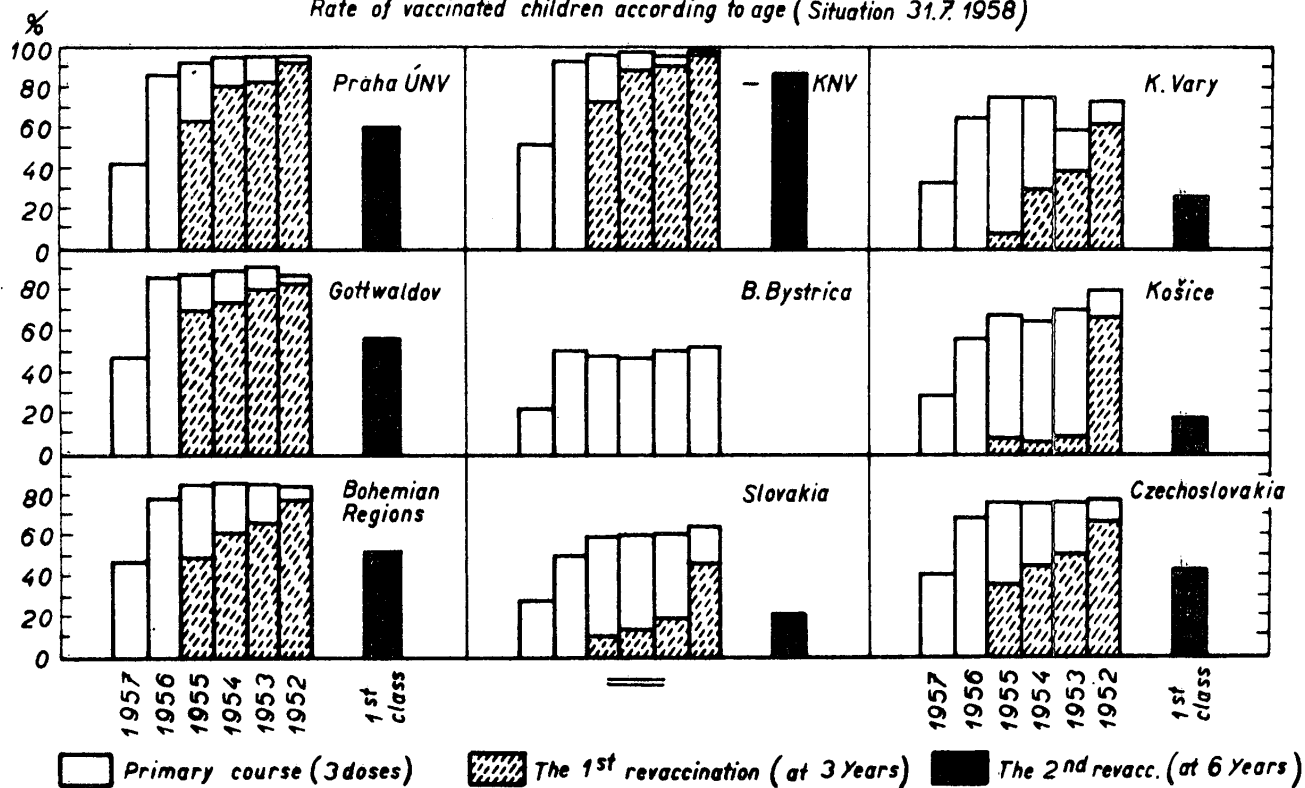






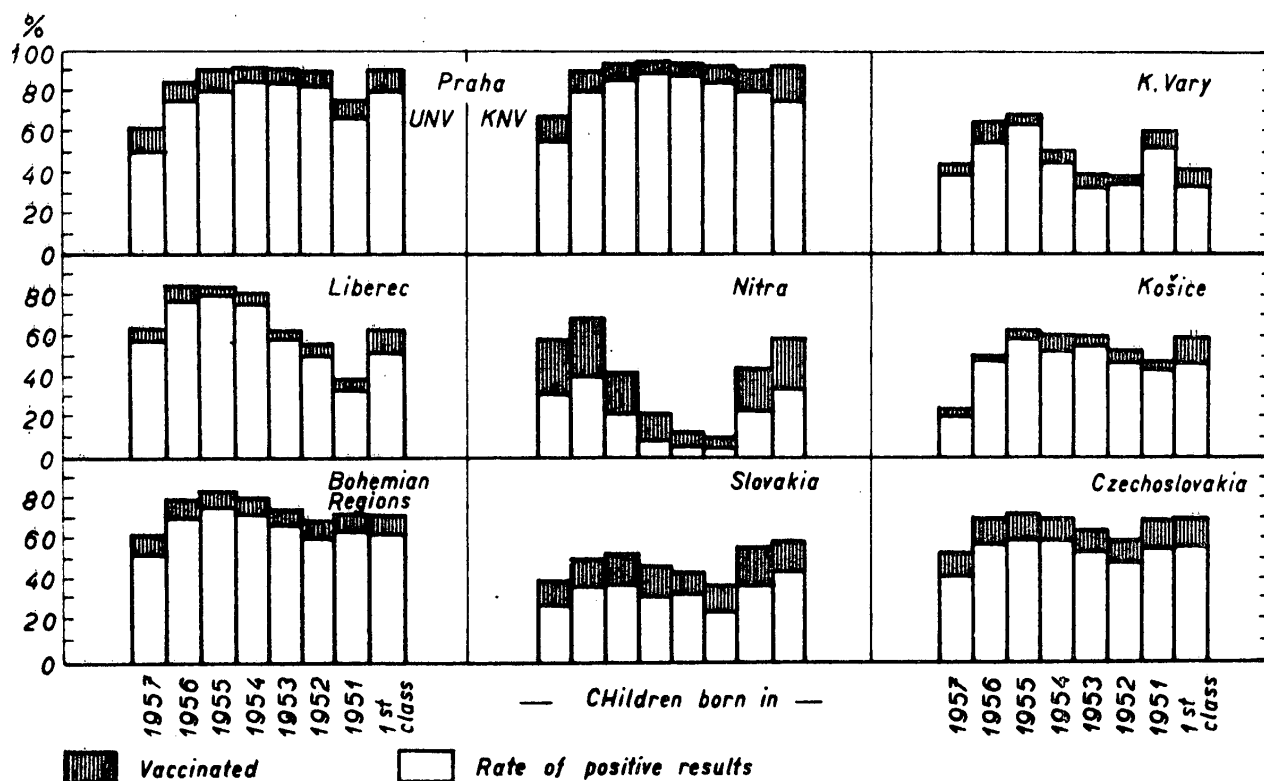
# VACCINATION AGAINST DIPHTHERIA

Rate of vaccinated children according to age (Situation 31.7. 1958)

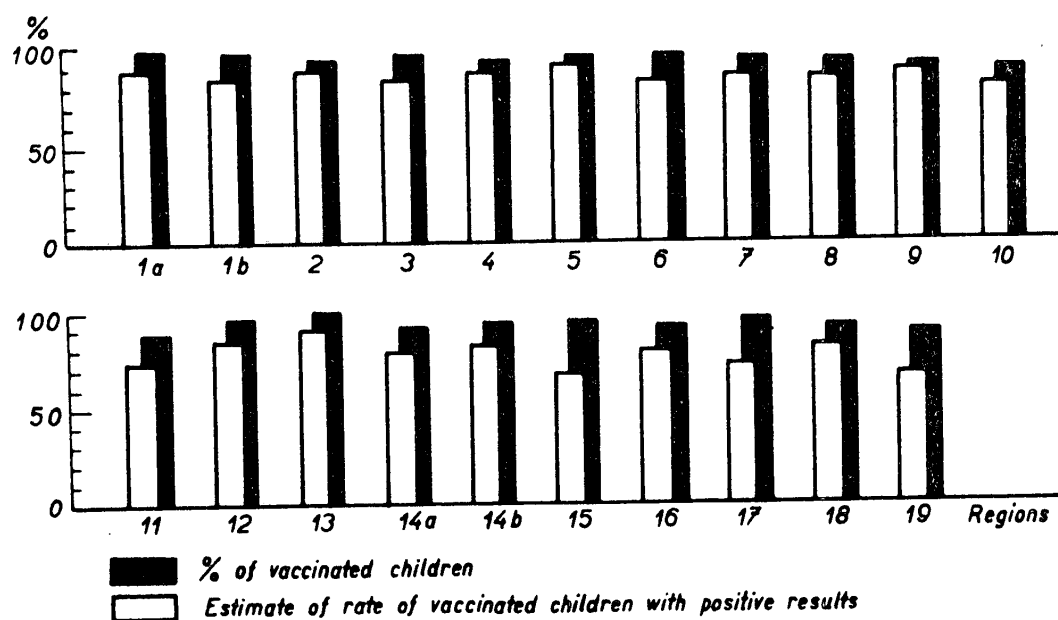


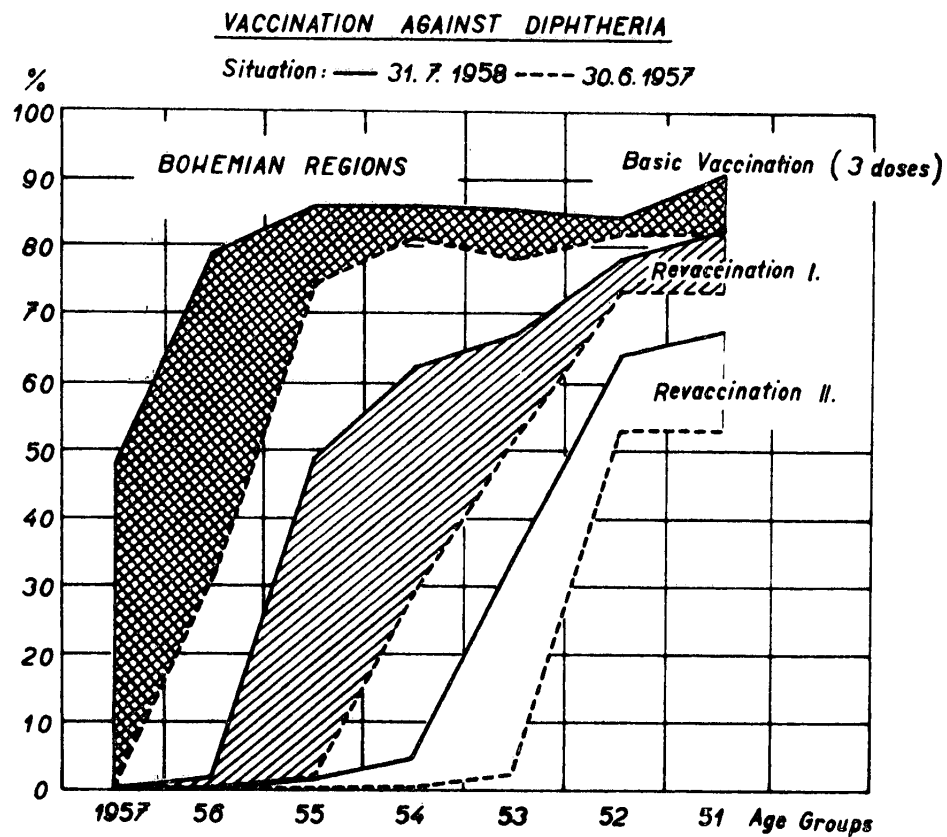
VACCINATION AGAINST SMALLPOX (primary course)

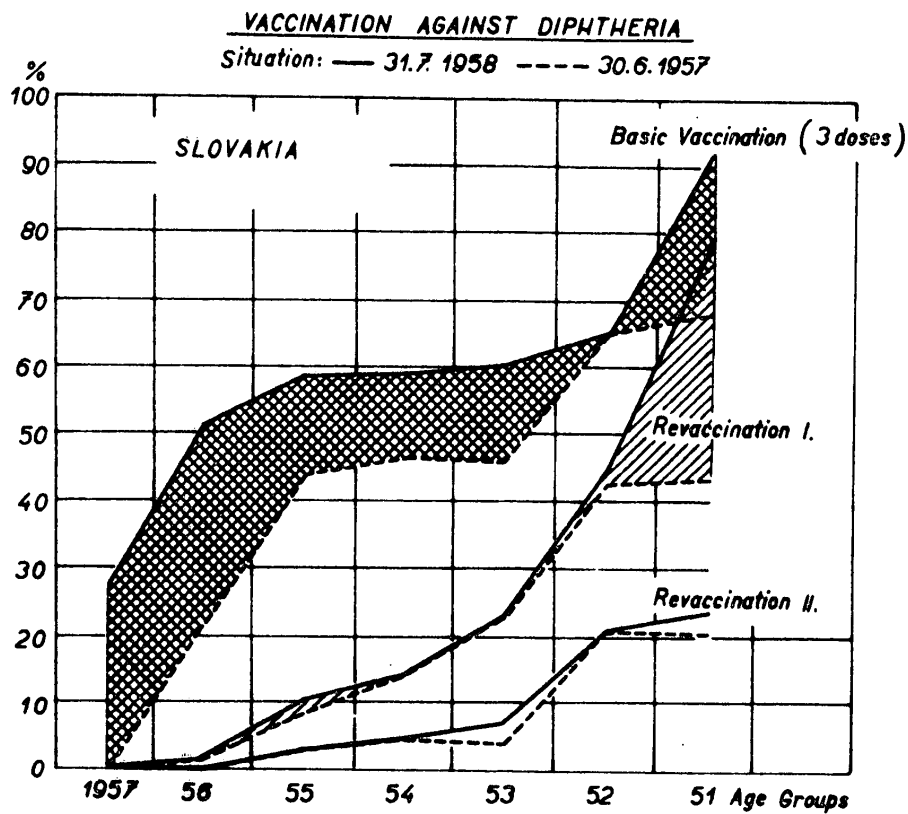
Rate of vaccinated children according to age - Situation 31.7. 1958

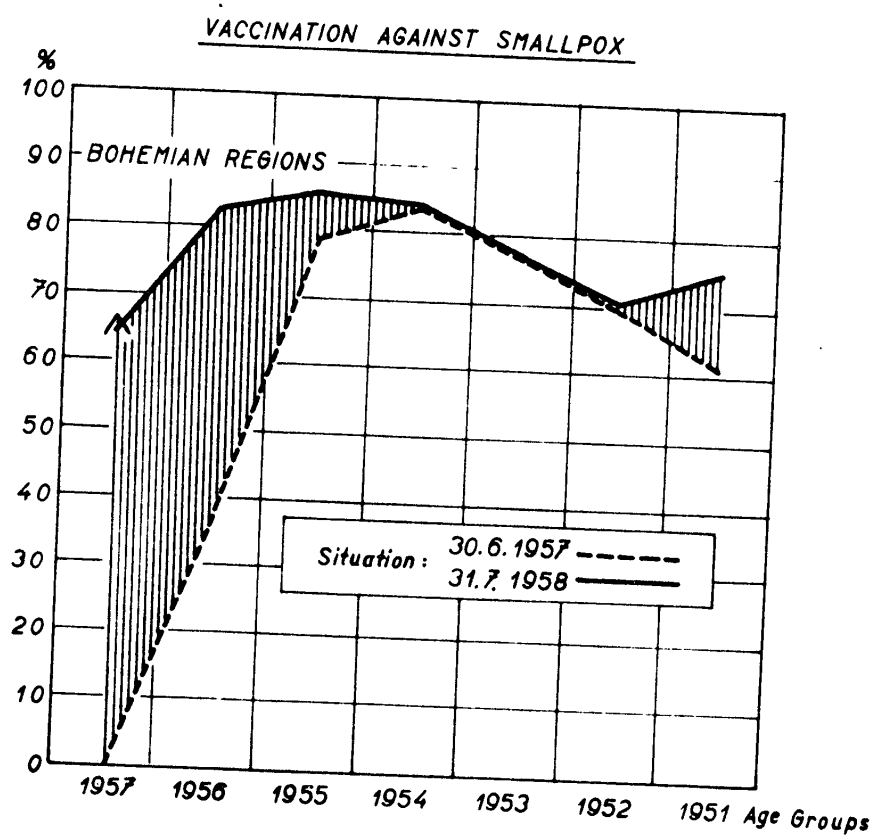


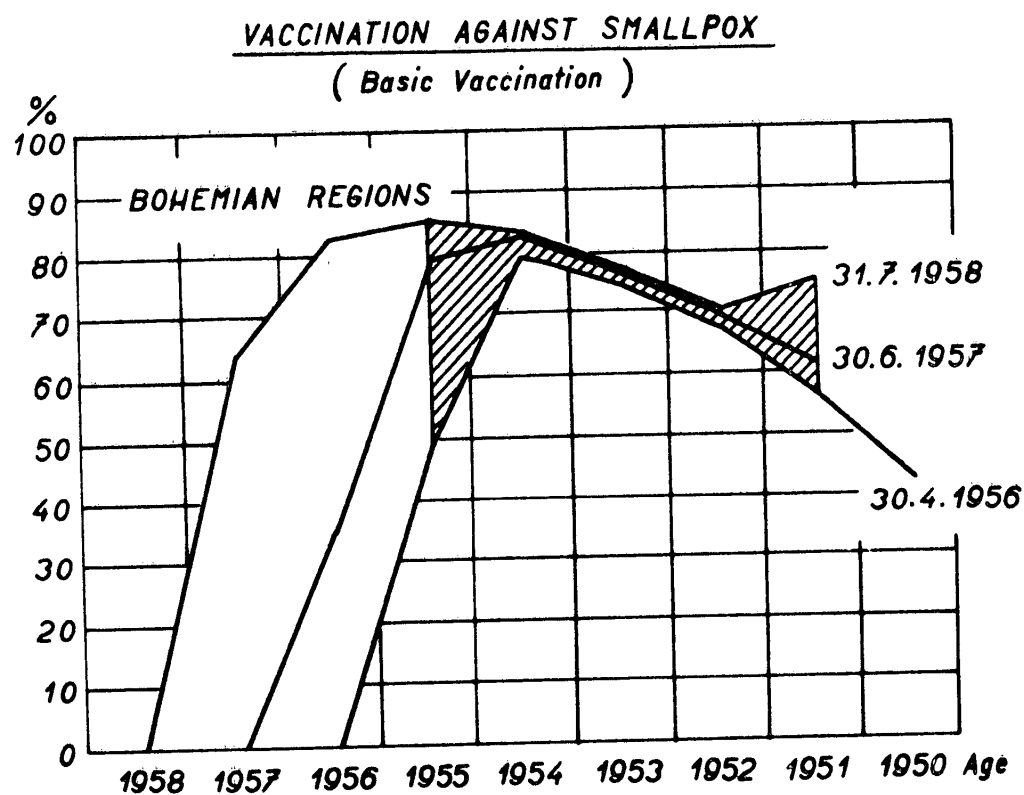
VACCINATION OF NEW-BORN CHILDREN AGAINST TUBERCULOSIS



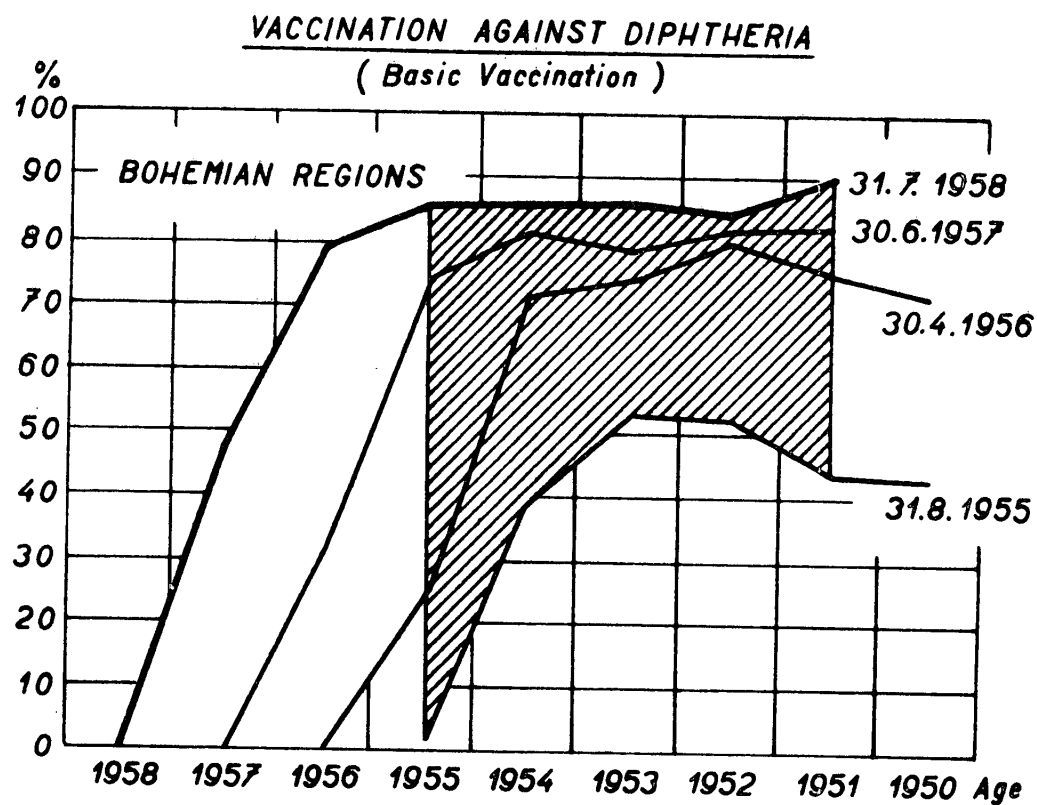




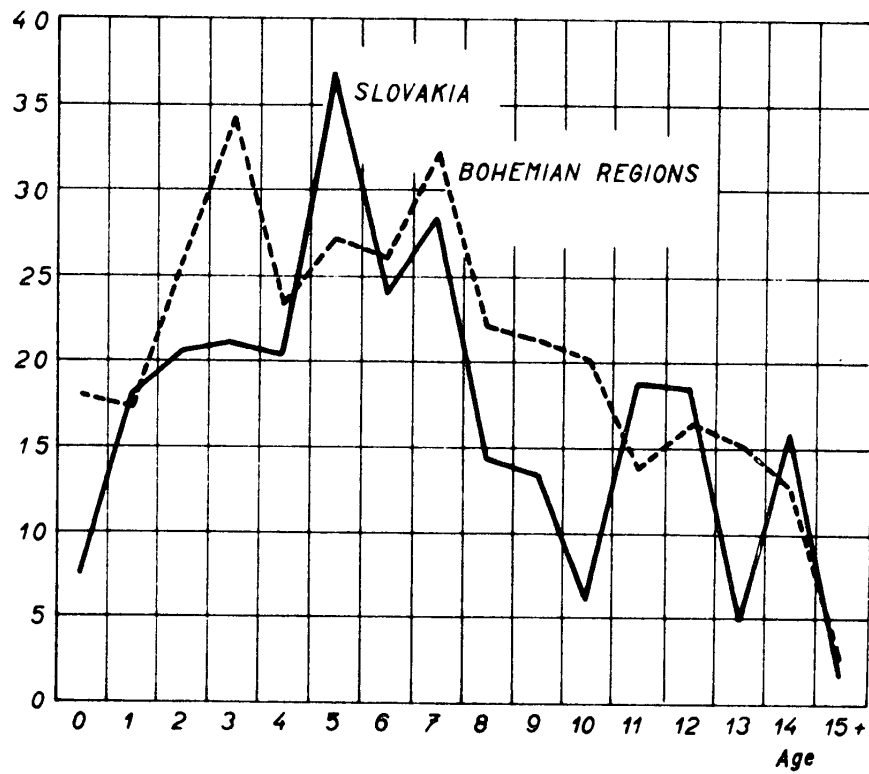






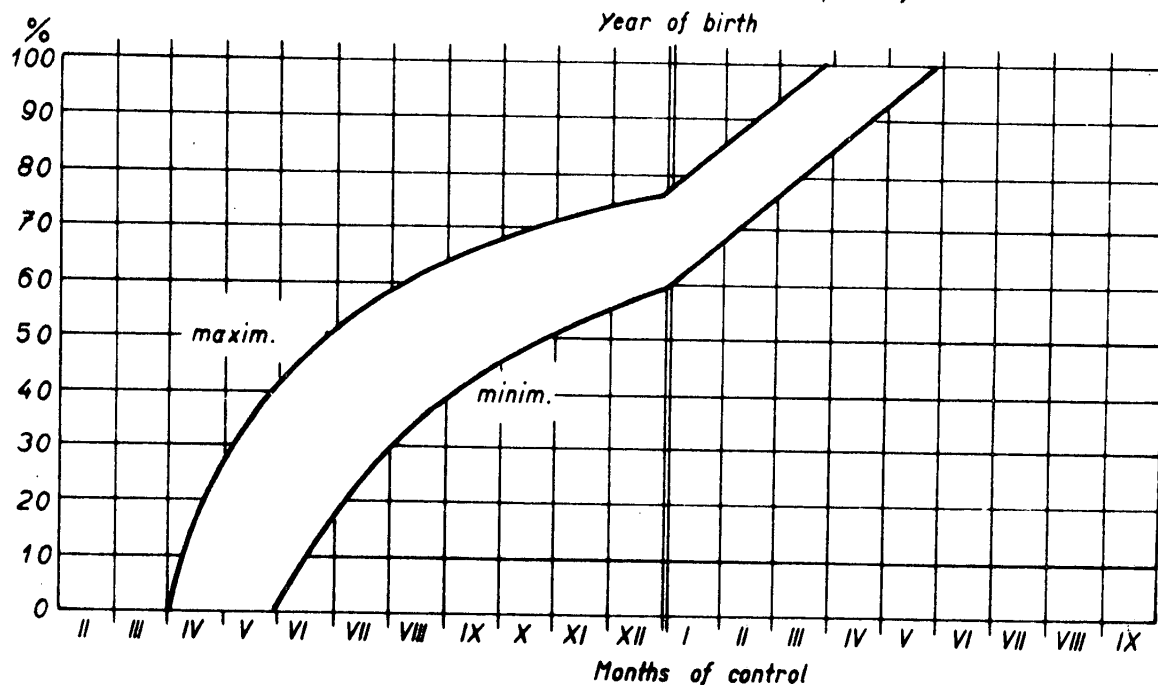


AGE MORBIDITY OF DIPHTHERIA IN CZECHOSLOVAKIA IN 1957  
*Per 100.000 population*



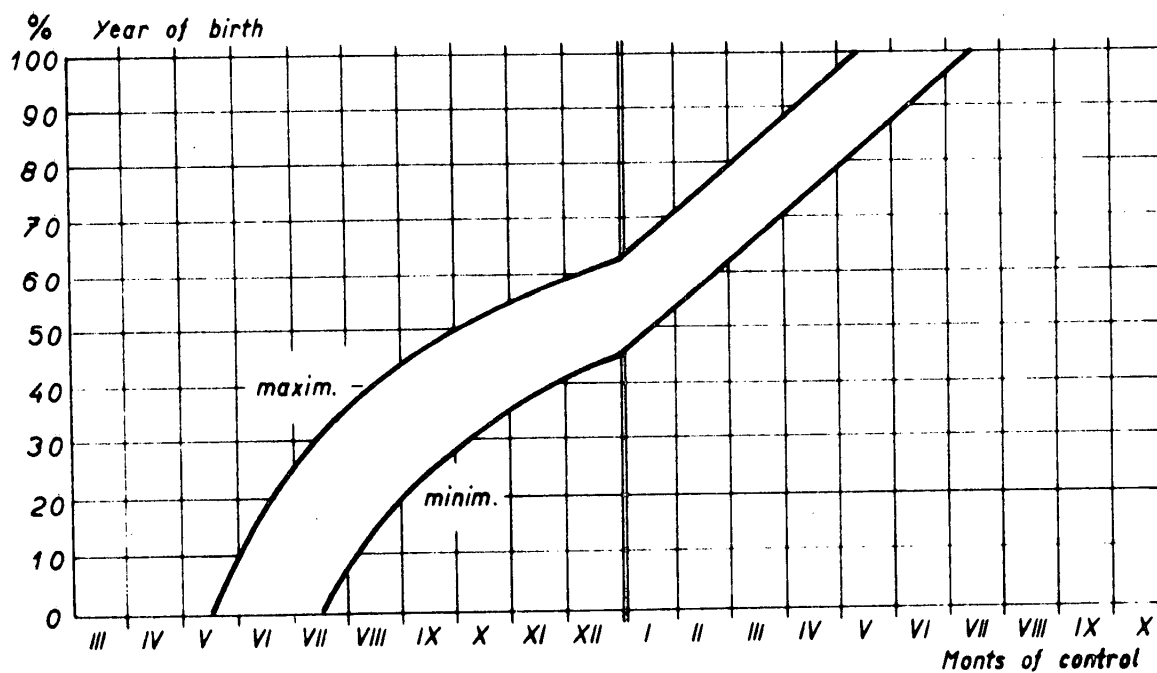
# VACCINATION AGAINST DIPHTHERIA

*Indicator of the highest (possible) and of the minimale (necessary) rate of vaccinated children with the 1st dose of the primary course*



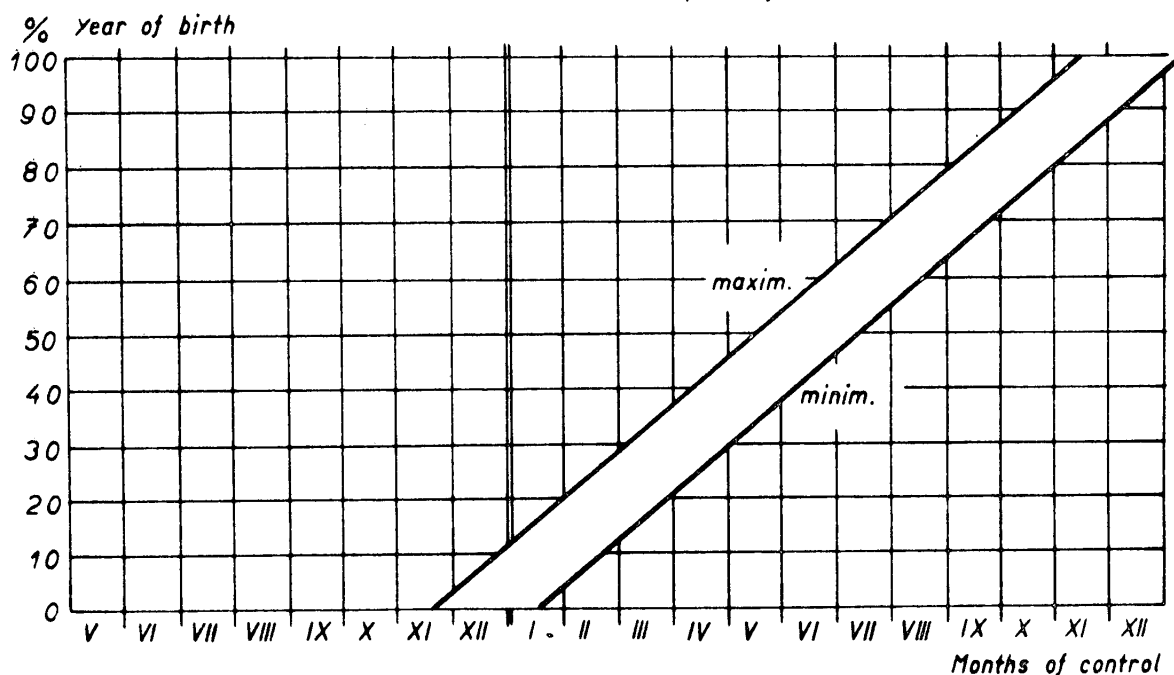
### VACCINATION AGAINST DIPHTHERIA

*Indicator of the highest (possible) and of the minimale (necessary) rate of vaccinated children  
with the 2<sup>nd</sup> dose of the primary course*



# VACCINATION AGAINST DIPHTHERIE

*Indicator of the highest (possible) and of the minimale (necessary) rate of vaccinated children with the 3<sup>rd</sup> dose of the primary course*



# VACCINATION AGAINST SMALLPOX (primary course)

Indicator of the highest (possible) and of the minimale (necessary) rate of vaccinated children

